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**Fanara**

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(54) **TRAINLINE COMMUNICATION NETWORK  
ACCESS POINT INCLUDING FILTER**

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See application file for complete search history.

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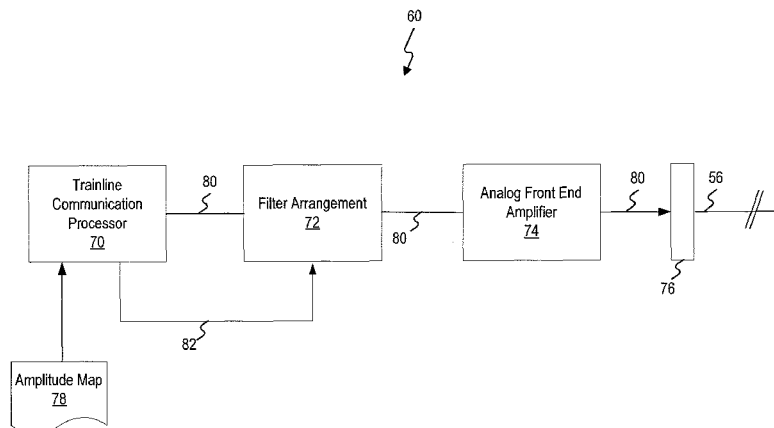
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(57) **ABSTRACT**

A trainline communication network access point has an intra-consist electrical cable connection point coupled to a transmission path and an intra-consist electrical cable, a processor, and a filter arrangement. The processor generates a data signal capable of transmitting network data over the intra-consist electrical cable. The processor determines from a plurality of possible transmit frequencies masked frequencies and non-masked frequencies and communicate the data signal on the transmission path on at least one of the non-masked frequencies and prevents communication of the data signal on the transmission path at the masked frequencies. The filter arrangement is disposed on the transmission path between the processor and the intra-consist electrical cable connection point and filters at least one of the masked frequencies from the transmission path.

**20 Claims, 4 Drawing Sheets**



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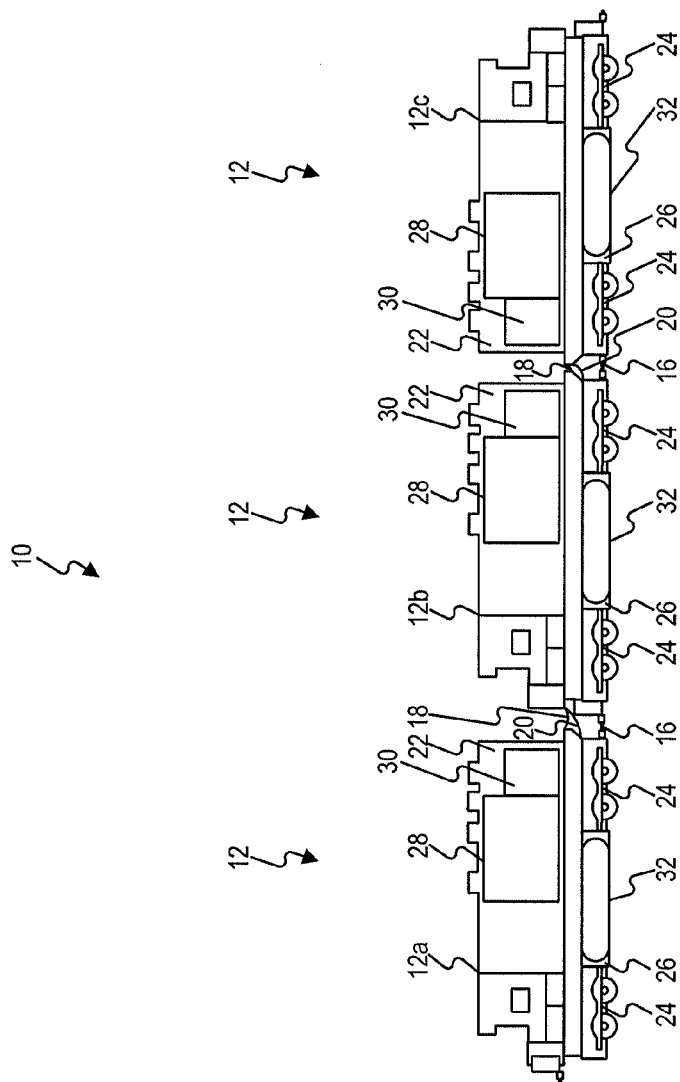
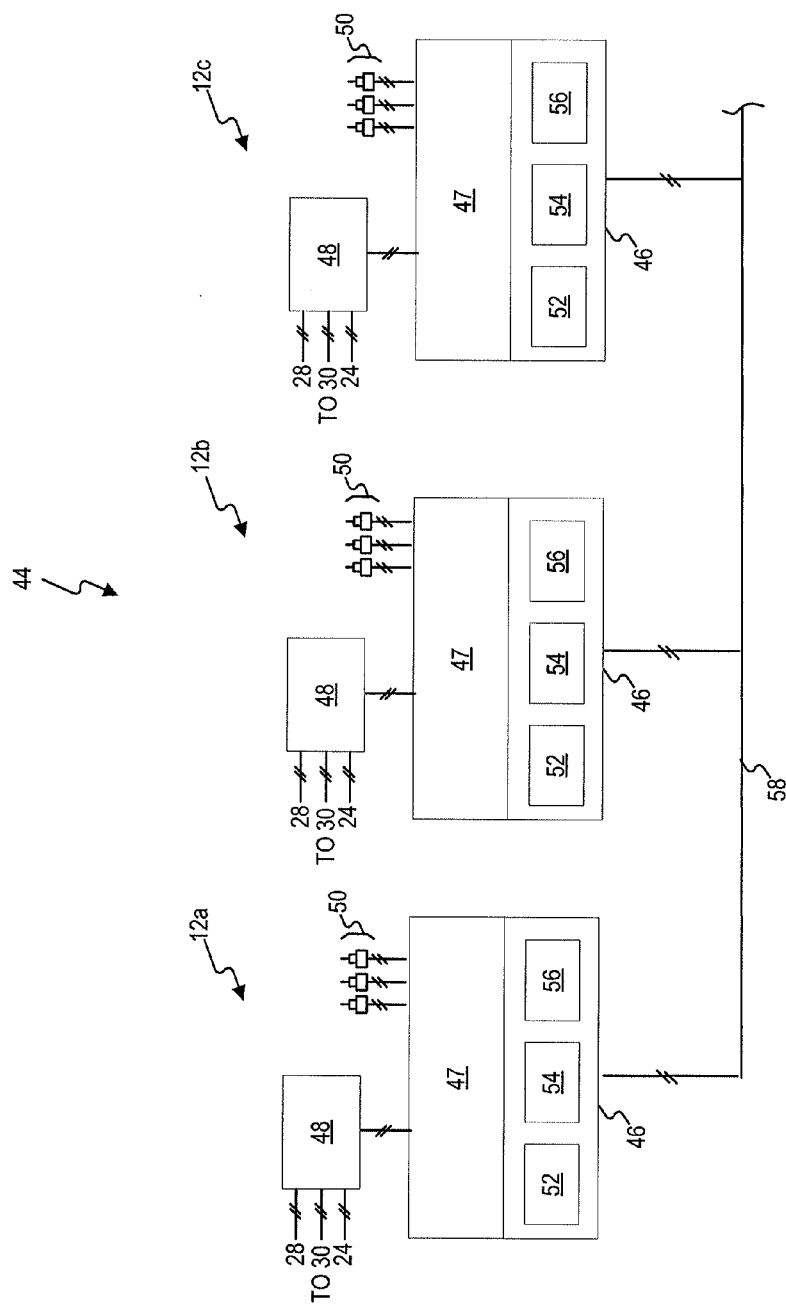


FIG. 1



**FIG. 2**

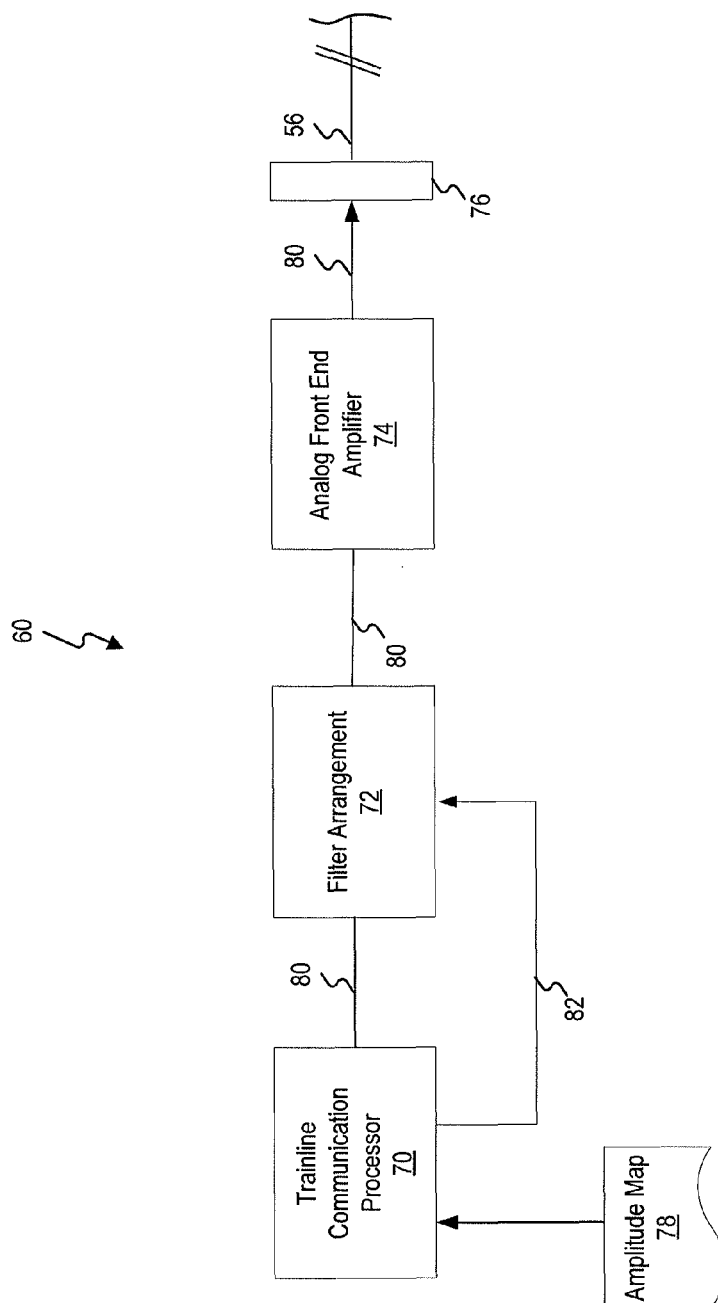


FIG. 3

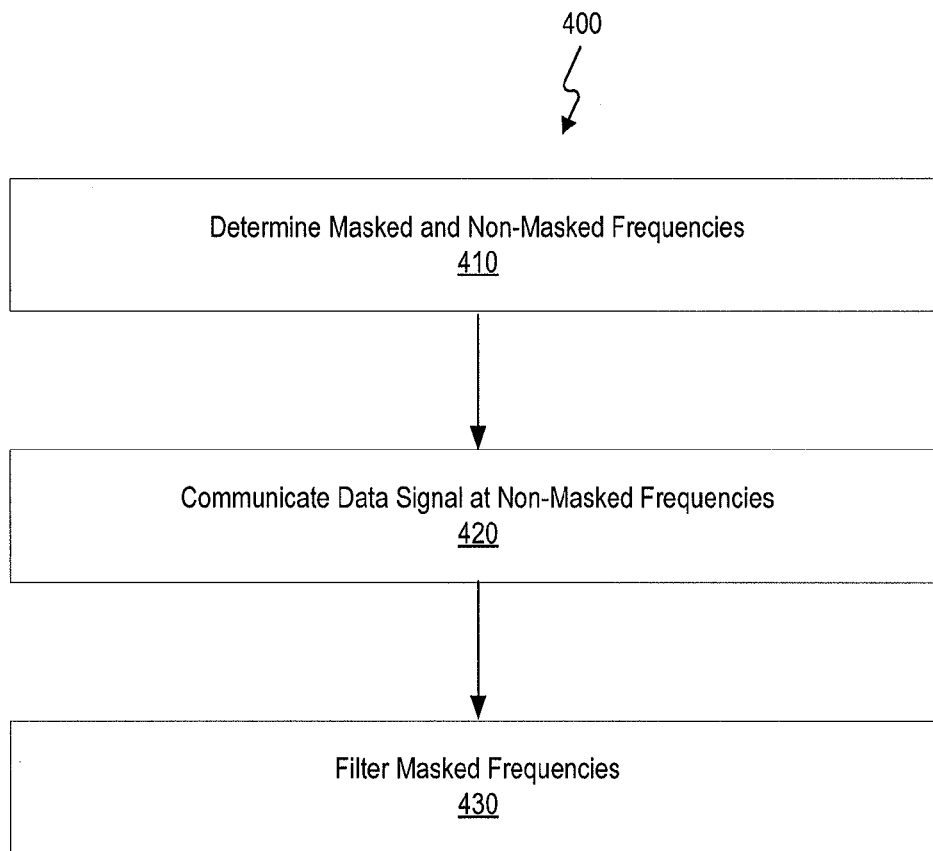


FIG. 4

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## TRAINLINE COMMUNICATION NETWORK ACCESS POINT INCLUDING FILTER

### TECHNICAL FIELD

The present disclosure relates generally to a trainline communication network, and more particularly, to a trainline communication network access point including a filter.

### BACKGROUND

A consist includes one or more locomotives that are coupled together to produce motive power for a train of rail vehicles. The locomotives each include one or more engines, which combust fuel to produce mechanical power. The engine(s) of each locomotive can be supplied with liquid fuel (e.g., diesel fuel) from an onboard tank, gaseous fuel (e.g., natural gas) from a tender car, or a blend of the liquid and gaseous fuels. The mechanical power produced by the combustion process is directed through a generator and used to generate electricity. The electricity is then routed to traction motors of the locomotives, thereby generating torque that propels the train. The locomotives can be connected together at the front of the train or separated and located at different positions along the train. For example, the consist can be positioned at the front, middle, or end of the train. In some instances, more than one consist can be included within a single train. The locomotives in a consist can be oriented in a forward-facing (or “long hood”) direction or a backward-facing (or “short hood”) direction. In some consists, the locomotives include computer systems for maintaining operations of the locomotive. These computer systems are sometimes disposed on the long hood side of the locomotive.

Because the locomotives of a consist must cooperate to propel the train, communication between the locomotives can be important. Historically, this communication has been facilitated through the use of an MU (Multi-Unit) cable that extends along the length of the consist. An MU cable is comprised of many different wires, each capable of carrying a discrete signal used to regulate a different aspect of consist operation. For example, a lead locomotive generates current within a particular one of the wires to indicate a power level setting requested by the train operator. When this wire is energized, the engines of all trail locomotives are caused to operate at a specific throttle value. In another example, when one locomotive experiences a fault condition, another of the wires is energized to alert the other locomotives of the condition’s existence.

Although acceptable in some applications, the information traditionally transmitted via the MU cable may be insufficient in other applications. For example, during the fault condition described above, it can be important to know a severity and/or cause of the fault condition so that an appropriate response to the fault condition can be implemented in an effective and efficient manner. Additionally, as consist configurations become more complex, for example during multi-unit blended fuel operations (i.e., operations where gaseous fuel from a tender car is simultaneously supplied to multiple locomotives and mixed with diesel fuel at different rates), control of the locomotives and/or the tender car may require a greater amount of cooperation and/or more complex communication than can be provided via the MU cable.

One attempt to address the above-described problems is disclosed in U.S. Patent Publication 2010/0241295 of Cooper et al. that published on Sep. 23, 2010 (“the ‘295

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publication”). Specifically, the ‘295 publication discloses a consist having a lead locomotive and one or more trail locomotives connected to each other via an MU cable. Each locomotive includes a computer unit, which, along with the MU cable, forms an Ethernet network in the train. With this configuration, network data can be transmitted from the computer unit in the lead locomotive to the computer units in the trail locomotives. The network data includes data that is packaged in packet form as data packets and uniquely addressed to particular computer units. The network data can be vehicle sensor data indicative of vehicle health, commodity condition data, temperature data, weight data, and security data. The network data is transmitted orthogonal to conventional non-network (i.e., command) data that is already being transmitted on the MU cable.

While the consist of the ‘295 publication may have improved communication between locomotives, it may still be less than optimal. In particular, it provides less than optimal filtering for preventing the transmission of network data at frequencies that could interfere with other equipment of the consist.

The system of the present disclosure solves one or more of the problems set forth above and/or other problems with existing technologies.

### SUMMARY

In one aspect, the present disclosure is directed to a trainline communication network access point including an intra-consist electrical cable connection point coupled to a transmission path and an intra-consist electrical cable, a processor, and a filter arrangement. The processor generates a data signal capable of transmitting network data over the intra-consist electrical cable. The processor determines from a plurality of possible transmit frequencies masked frequencies and non-masked frequencies and communicates the data signal on the transmission path on at least one of the non-masked frequencies and prevents communication of the data signal on the transmission path at the masked frequencies. The filter arrangement is disposed on the transmission path between the processor and the intra-consist electrical cable connection point and filters at least one of the masked frequencies from the transmission path.

In another aspect, the present disclosure is directed to a method for communicating a data signal using a trainline communication network access point. The method includes generating a data signal capable of transmitting network data over an intra-consist electrical cable, and determining masked frequencies and non-masked frequencies from a plurality of possible transmit frequencies. The method further includes communicating the data signal on the transmission path on at least one of the non-masked frequencies and preventing communication of the data signal on the transmission path at the masked frequencies. A filter arrangement disposed on a transmission path between a trainline communication processor and an intra-consist electrical cable connection point connected to the intra-consist electrical cable filters at least one of the masked frequencies from the transmission path.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a pictorial illustration of an exemplary disclosed consist;

FIG. 2 is a diagrammatic illustration of an exemplary disclosed communication system that may be used in conjunction with the consist of FIG. 1;



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FIG. 3 is a diagrammatic illustration of an exemplary trainline communication network access point for use with the communication system of FIG. 2; and

FIG. 4 is a flowchart illustrating an exemplary disclosed method for filtering data signals that can be performed by the trainline communication network access point of FIG. 3.

#### DETAILED DESCRIPTION

FIG. 1 illustrates an exemplary train consist 10 having one or more locomotives 12. In the disclosed embodiment, consist 10 has three different locomotives 12, including a lead locomotive 12a and two trailing locomotives 12b, 12c. It is contemplated, however, that consist 10 can include any number of locomotives 12 and other cars (e.g. tender cars), and that locomotives 12 can be located in any arrangement and in any orientation (e.g., forward-facing or rear-facing). Consist 10 can be located at the front of a train of other rail vehicles (not shown), within the train of rail vehicles, or at the end of the train of rail vehicles. It is also contemplated that more than one consist 10 can be included within a single train of rail vehicles, if desired, and/or that consist 10 can travel at times without a train of other rail vehicles.

Each locomotive 12 can be connected to an adjacent locomotive 12 in several different ways. For example, locomotives 12 can be connected to each other via a mechanical coupling 16, one or more fluid couplings 18, and one or more electrical couplings 20. Mechanical coupling 16 can be configured to transmit tractive and braking forces between locomotives 12. Fluid couplings 18 may be configured to transmit fluids (e.g., fuel, coolant, lubrication, pressurized air, etc.) between locomotives 12. Electrical couplings 20 can be configured to transmit power and/or data (e.g., data in the form of electrical signals) between locomotives 12. In one example, electrical couplings 20 include an intra-consist electrical cable, such as a MU cable, configured to transmit conventional command signals and/or electrical power. In another example, electrical couplings 20 include a dedicated data link configured to transmit packets of data (e.g., Ethernet data). In yet another example, the data packets can be transmitted via the intra-consist electrical cable. It is also contemplated that some data can be transmitted between locomotives 12 via a combination of the intra-consist electrical cable, the dedicated data link, and/or other means (e.g., wirelessly), if desired.

Each locomotive 12 can include a car body 22 supported at opposing ends by a plurality of trucks 24 (e.g., two trucks 24). Each truck 24 can be configured to engage a track (not shown) via a plurality of wheels, and to support a frame 26 of car body 22. Any number of engines 28 can be mounted to frame 26 within car body 22 and drivingly connected to a generator 30 to produce electricity that propels the wheels of each truck 24. Engines 28 can be internal combustion engines configured to combust a mixture of air and fuel. The fuel can include a liquid fuel (e.g., diesel) provided to engines 28 from a tank 32 located onboard each locomotive 12 or via fluid couplings 18, and/or a blended mixture of the liquid and gaseous fuels.

As shown in FIG. 2, consist 10 can be equipped with a communication system 44 that facilitates coordinated control of locomotives 12. Communication system 44 can include, among other things, an access point 46 for each locomotive 12. Each access point 46 can be connected to one or more wired and/or wireless networks, and used to communicate command signals and/or data between controllers 48 of each rail vehicle and various other network components 50 (e.g., sensor, valves, pumps, heat exchangers,

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accumulators, regulators, actuators, GPS components, etc.) that are used to control locomotives 12. Access points 46 can be connected to each other via electrical couplings 20 (e.g., via the intra-consist electrical cable, via the dedicated data link, and/or wirelessly). Access points 46 can be connected to a local area network hub ("LAN hub") 47 that facilitates communication between the controllers 48, the network components 50, and access points 46.

Each access point 46 can include an inter-consist router ("IC router") 52, an Ethernet bridge 54, and an MU modem 56, as well as conventional computing components known in the art (not shown) such as a processor, input/output (I/O) ports, a storage, a memory. The I/O ports may facilitate communication between the associated access point 46 and the LAN hub 47. In some embodiments, the I/O ports may facilitate communication between the associated access point 46 and one or more of network components 50.

Likewise, IC router 52 can facilitate communication between different access points 46 of locomotives 12 that are connected to each other via electrical couplings 20. In some embodiments, IC router 52 can provide a proxy IP address corresponding to controllers 48 and network components 50 of remote locomotives. For example, IC router 52 can provide a proxy IP address for one of network components 50 of locomotive 12b so controller 48 of locomotive 12a can communicate with it. The IC router 52 can include, or be connected to, an Ethernet bridge 54 that can be configured to translate network data to an electrical signal capable of being sent through intra-consist electrical cable 58. Ethernet bridge 54 can include or be connected to MU modem 56. MU modem 56 can be configured to modulate a carrier signal sent over intra-consist electrical cable 58 with the electrical signal received from Ethernet bridge 54 to transmit network data between access points 46. MU modem 56 can also be configured to demodulate signals received from access points 46 and send the demodulated signals to Ethernet bridge 54 for conversion to network data destined to controller 48 or network components 50. In some embodiments, MU modem 56 sends network data orthogonal to data traditionally transmitted over intra-consist electrical cable 58 (e.g., control data). Although FIG. 2 illustrates IC router 52, Ethernet bridge 54, and MU modem 56 as separate components, in some embodiments, one component can perform the functionality of two components. For example, Ethernet bridge 54 may perform the operations described above with respect to IC router 52, or Ethernet bridge 54 can include, or perform the operations of, MU modem 56.

In some embodiments, access point 46, IC router 52, Ethernet bridge 54, and/or MU modem 56 can include a processor, storage, and/or memory (not shown). The processor can include one or more processing devices, such as microprocessors and/or embedded controllers. The storage can include volatile or non-volatile, magnetic, semiconductor, tape, optical, removable, non-removable, or other type of computer-readable medium or computer-readable storage device. The storage can be configured to store programs and/or other information that can be used to implement one or more of the processes discussed below. The memory can include one or more storage devices configured to store information.

Each controller 48 can be configured to control operational aspects of its related rail vehicle. For example, controller 48 of lead locomotive 12a can be configured to control operational aspects of its corresponding engine 28, generator 30, traction motors, operator displays, and other associated components. Likewise, the controllers 48 of trail locomotives 12b and 12c can be configured to control

operational aspects of their corresponding engines **28**, generators **30**, traction motors, operator displays, and other associated components. In some embodiments, controller **48** of lead locomotive can be further configured to control operational aspects of trail locomotives **12b** and **12c**, if desired. For example, controller **48** of lead locomotive **12a** can send commands through its access point **46** to the access points of trail locomotives **12b** and **12c**.

Each controller **48** can embody a single microprocessor or multiple microprocessors that include a means for controlling an operation of the associated rail vehicle based on information obtained from any number of network components **50** and/or communications received via access points **46**. Numerous commercially available microprocessors can be configured to perform the functions of controller **48**. Controller **48** can include a memory, a secondary storage device, a processor, and any other components for running an application. Various other circuits may be associated with controller **48** such as power supply circuitry, signal conditioning circuitry, solenoid driver circuitry, and other types of circuitry.

The information obtained by a particular controller **48** via access points **46** and/or network components **50** can include performance related data associated with operations of each locomotive **12** ("operational information"). For example, the operational information can include engine related parameters (e.g., speeds, temperatures, pressures, flow rates, etc.), generator related parameters (e.g., speeds, temperatures, voltages, currents, etc.), operator related parameters (e.g., desired speeds, desired fuel settings, locations, destinations, braking, etc.), liquid fuel related parameters (e.g., temperatures, consumption rates, fuel levels, demand, etc.), gaseous fuel related parameters (e.g., temperatures, supply rates, fuel levels, etc.), and other parameters known in the art.

The information obtained by a particular controller **48** via access points **46** and/or network components **50** can also include identification data of the other rail vehicles within the same consist **10**. For example, each controller **48** can include stored in its memory the identification of the particular rail vehicle with which controller **48** is associated. The identification data can include, among other things, a type of rail vehicle (e.g., make, model, and unique identification number), physical attributes of the associated rail vehicle (e.g., size, load limit, volume, power output, power requirements, fuel consumption capacity, fuel supply capacity, etc.), and maintenance information (e.g., maintenance history, time until next scheduled maintenance, usage history, etc.). When coupled with other rail vehicles within a particular consist **10**, each controller **48** can be configured to communicate the identification data to the other controllers **48** within the same consist **10**. Each controller **48**, can be configured to selectively affect operation of its own rail vehicle based on the obtained identification data associated with the other rail vehicles of consist **10**.

In some embodiments, controllers **48** can be configured to affect operation of their associated rail vehicles based on the information obtained via access points **46** and/or network components **50** and one or more maps stored in memory. Each of these maps may include a collection of data in the form of tables, graphs, and/or equations. Controllers **48** can be configured to affect operation of their associated locomotives based on the position within a locomotive consist. The position of the locomotive associated with controller **48** can be used with the one or more maps to control the operation of the locomotive. For example, a map of throttle settings can be stored in the memory of controller **48**. The map of throttle settings can include a mapping of consist

position to throttle setting. For example, when the locomotive of controller **48** is the lead locomotive (e.g., in first position in the consist) the map may indicate that controller **48** should set the throttle to Notch 4, and when the locomotive of controller **48** is the third trail locomotive (e.g., in fourth position in the consist), the map may indicate that controller **48** should set the throttle to Notch 2.

According to some embodiments, access point **46** can include one or more components for filtering signals transmitted on intra-consist electrical cable **58**. Filtering of transmitted signals can be important to prevent interference with components operating a certain frequencies. For example, personnel working on consist **10** may make use of hand-held communication devices that operate over radio waves at certain frequencies. When signals are sent over intra-consist electrical cable **58** on those same frequencies, the signals can interfere with the communication between hand-held communication devices. In addition, communication between hand-held communication devices can interfere with data signals sent over intra-consist electrical cable **58**. Thus, it can be advantageous to prevent communication system **44** from using one or more frequencies that interfere with other devices (e.g., hand-held communication devices) operating on or near consist **10**.

In conventional embodiments, preventing communication system **44** from using certain frequencies can be done using an amplitude map. An amplitude map can be a data structure that can be read by one or more components of access point **46** to determine the signal amplitude for various carrier frequencies that are used to send data over intra-consist electrical cable **58**. To mask a frequency from use by communication system **44**, the corresponding amplitude for the masked frequency can be set to zero in the amplitude map. Zeroing the masked frequency can be referred to as "notching" the frequency. Due to the inefficient notching mechanism provided by conventional embodiments, conventional embodiments require that the amplitude map also notch several frequencies close to the frequency that is to be masked. For example, when masking a 1000 MHz frequency, the amplitude map may notch 1000 MHz as well as frequency ranges from 980 MHz-1020 MHz. Notching frequency bands that are adjacent to the masked frequency can create a loss in bandwidth that can be undesirable when large amounts of data are being communicated between locomotives **12** of consist **10** or when a large number of notches are required. Accordingly, the disclosed communication system **44** provides a trainline communication network access point including a filter arrangement designed to filter desired masked frequencies thereby allowing use of one or more frequencies that would need to be notched in conventional embodiments.

FIG. 3 is an illustration of an exemplary trainline communication network access point **60** for use within communication system **44**. For ease of discussion, FIG. 3 discloses exemplary components of trainline communication network access point **60** that can be used to filter signals that trainline communication network access point **60** transmits, but trainline communication network access point **60** can contain additional components that are not described with respect to FIG. 3. For example, trainline communication network access point **60** can contain one or more components of access point **46** as described above with respect to FIG. 2. Further, one or more components of trainline communication network access point **60** can be disposed within one of the components of access point **46** as described above. For example, the components of trainline communication network access point **60** could be disposed within IC router **52**,

Ethernet bridge **54**, or MU modem **56**. In some embodiments, trainline communication network access point **60** can include a motherboard with one or more expansion slots for accepting daughtercards to enhance its functionality, and the operation of one or more components of trainline communication network access point **60** can be embodied on a daughtercard configured to interface with the motherboard. For example, filter arrangement **72** can be embodied as a daughtercard.

According to some embodiments, trainline communication network access point **60** operates to increase bandwidth of communication system **44**. Trainline communication network access point **60** can include several components such as trainline communication processor **70**, filter arrangement **72**, analog front end amplifier **74**, and intra-consist electrical cable connection point **76**. The trainline communication network access point **60** can be connected by signal paths that are configured to transmit or receive digital or analog signals between the components of trainline communication network access point **60**. For example, trainline communication access point **60** can include transmission signal path **80** and command signal path **82**.

Trainline communication processor **70** can perform operations to enable trainline communication network access point **60** to perform network communications over intra-consist electrical cable **58**. Trainline communication processor **70** can receive incoming signals via a receive path (not shown). The incoming signals can include a modulated signal containing network data to be processed by trainline communication processor **70**, or some other component of access point **46**. Conventionally, analog front end amplifier **74** receives transmit signals on transmission signal path **80** and amplifies or attenuates the signals before they are sent to intra-consist electrical cable connection point **76** for communication over intra-consist electrical cable **58**.

In some embodiments, trainline communication processor **70** can perform or control operations for modulating or demodulating signals that communicate network data over intra-consist electrical cable **58**. Trainline communication processor **70** can determine masked and non-masked carrier frequencies used for modulation and demodulation based on amplitude map **78**. As described above, amplitude map **78** can include a data structure specifying the amplitudes of frequencies used for modulation in communication system **44**. Amplitude map **78** can be a data structure stored in memory, a database, or a configuration file, for example, that is accessible locally or remotely by trainline communication processor **70**. When trainline communication processor **70** generates a data signal capable of transmitting network data over intra-consist electrical cable **58**, it can refer to amplitude map **78** to determine the proper amplitude for the data signal. As described above, frequencies that trainline communication processor **70** cannot use to modulate data signals can be notched using amplitude map **78** by setting their respective amplitudes to zero.

Trainline communication network access point **60** can also include filter arrangement **72**. Filter arrangement **72** can include one or more filters configured to allow or prevent signals of certain frequencies that are communicated on transmission signal path **80**. The one or more filters of filter arrangement **72** can be band-pass filters, low-pass filters, high-pass filters, or notch (band-stop) filters. In some embodiments, filter arrangement **72** includes programmable filters that can be controlled to filter a first set of frequencies at one time and filter a second set of frequencies at a second time. For example, filter arrangement **72** can prevent transmission of signals at 1000 MHz and allow transmission of

signals at 1500 MHz at a first time, and allow transmission of signals at 1000 MHz and prevent transmission of signals at 1500 MHz at a second time. The use of programmable filters allows filter arrangement **72** to adjust its filtering based on operational needs. Filter arrangement **72** can also include one or more non-programmable filters. Filter arrangement **72** can include analog filters, digital filters, or both.

Filter arrangement **72** can be connected to transmission signal path **80** and disposed between trainline communication processor **70** and analog front end amplifier **74** (as shown in FIG. 3). In such embodiments, filter arrangement **72** filters signals transmitted on transmission signal path **80** before the signals are amplified by analog front end amplifier **74**. In some embodiments, filter arrangement **72** can be connected to transmission signal path **80** and disposed between analog front end amplifier **74** and intra-consist electrical cable connection point **76**. In such embodiments, filter arrangement **72** filters signals transmitted on transmission signal path **80** after the signals are amplified by analog front end amplifier **74**. In some embodiments, filter arrangement **72** can be connected to transmission signal path **80** and include a first arrangement of filters disposed between trainline communication processor **70** and analog front end amplifier **74** and a second arrangement of filters disposed between analog front end amplifier **74** and intra-consist electrical cable connection point **76**. In such embodiments, filter arrangement **72** filters signals transmitted on transmission signal path **80** before and/or after the signals are amplified by analog front end amplifier **74**.

In some embodiments, filter arrangement **72** can be controlled by trainline communication processor **70**. Filter arrangement **72** can be connected to command signal path **82** and can detect control signals that are sent by trainline communication processor **70** on command signal path **82**. The control signals can specify one or more frequencies to filter from the data signals transmitted on transmission signal path **80**. Based on the detected control signals, filter arrangement **72** can set one or more programmable filters to prevent the communication of signals at the frequencies identified in the control signal. In some embodiments, trainline communication processor **70** determines masked frequencies (e.g., those are not to be used as carrier frequencies) and non-masked frequencies (e.g., those that can be used as carrier frequencies) by reading amplitude map **78**. Based on the masked and non-masked frequencies determined from amplitude map **78**, trainline communication processor **70** generates a control signal and communicates it to filter arrangement **72** on command signal path **82**. In some embodiments, filter arrangement **72** can be configured to read amplitude map **78** and filter any frequencies that have been notched in it. Further operations of trainline communication network access point **60** are described in greater detail below with respect to FIG. 4.

#### INDUSTRIAL APPLICABILITY

The disclosed trainline communication network access point can be applicable to any consist that includes a plurality of rail cars, such as locomotives. The disclosed trainline communication network access point can provide more finely tuned notching of frequencies than that of conventional embodiments thereby increasing the potential bandwidth of a trainline communication system used for communication by locomotives in a consist. The operation of the disclosed trainline communication network access point will now be explained.

FIG. 4 is a flowchart illustrating an exemplary disclosed method 400 for filtering data that can be performed by one of the components illustrated in FIG. 3. During the operation of consist 10, trainline communication network access point 60 can perform method 400 to filter data signals using filter arrangement 72. Although the description that follows describes method 400 as being performed by trainline communication network access point 60, other components of access point 46 can perform one or more of the steps of method 400 in some embodiments.

Trainline communication network access point 60 begins method 400 by determining masked and non-masked frequencies (step 410). Masked frequencies can include those frequencies that can serve as carrier frequencies in communication system 44. Non-masked frequencies can include those frequencies that cannot serve as carrier frequencies in communication system 44 due to interference with other components of consist 10. Trainline communication network access point 60 can determine the masked and non-masked frequencies by accessing amplitude map 78 and determining whether any frequencies in amplitude map 78 are associated with a zero amplitude. Those frequencies in amplitude map 78 with zero amplitudes can be masked frequencies, and those frequencies in amplitude map 78 with non-zero amplitudes can be non-masked frequencies.

Next, trainline communication network access point 60 communicates a data signal at non-masked frequencies (step 420). As noted above, trainline communication network access point 60 can include trainline communication processor 70, which can generate the data signal and modulate it with a carrier frequency selected from the non-masked frequencies. The data signal is sent along transmission signal path 80 and filtered by filter arrangement 72 (step 430). Once filtered, the data signal can be communicated over intra-consist electrical cable 58 to a destination access point of another locomotive of consist 10.

Several advantages over the prior art may be associated with the trainline communication network access point. For example, the disclosed trainline communication network access point can prevent transmission of signals at frequencies that cause interference with other equipment operating on a locomotive consist. In addition, as described herein, the disclosed trainline communication network access point can include a filter arrangement that provides more finely tuned notching of frequencies thereby increasing the potential bandwidth of a trainline communication system used by locomotives in a consist.

It will be apparent to those skilled in the art that various modifications and variations can be made to the trainline communication network access point. Other embodiments will be apparent to those skilled in the art from consideration of the specification and practice of the disclosed trainline communication network access point. It is intended that the specification and examples be considered as exemplary only, with a true scope being indicated by the following claims and their equivalents.

What is claimed is:

1. A trainline communication network access point comprising:
  - a transmission path;
  - an intra-consist electrical cable connection point coupled to the transmission path and configured to couple to an intra-consist electrical cable;
  - a processor configured to:
    - generate a data signal capable of transmitting network data over the intra-consist electrical cable,

- determine, from a plurality of possible transmit frequencies, masked frequencies and non-masked frequencies,
  - communicate the data signal on the transmission path on at least one of the non-masked frequencies, and prevent communication of the data signal on the transmission path at the masked frequencies; and
  - a filter arrangement disposed on the transmission path between the processor and the intra-consist electrical cable connection point, the filter arrangement configured to filter at least one of the masked frequencies from the transmission path.
2. The trainline communication network access point of claim 1 further including an analog front end amplifier connected to the transmission path and configured to amplify the data signal.
3. The trainline communication network access point of claim 2 wherein the filter arrangement is disposed on the transmission path between the processor and the analog front end amplifier.
4. The trainline communication network access point of claim 2 wherein the filter arrangement is disposed on the transmission path between the analog front end amplifier and the intra-consist electrical cable connection point.
5. The trainline communication network access point of claim 1 wherein the filter arrangement includes a plurality of filters.
6. The trainline communication network access point of claim 1 wherein the filter arrangement includes a programmable filter.
7. The trainline communication network access point of claim 6 wherein the processor is further configured to command the filter arrangement to filter the at least one of the masked frequencies from the transmission path.
8. The trainline communication network access point of claim 1 wherein the processor is configured to determine the masked frequencies and the non-masked frequencies based on an amplitude map.
9. The trainline communication network access point of claim 1 wherein the filter arrangement is configured to filter the at least one of the masked frequencies from the transmission path based on an amplitude map.
10. The trainline communication network access point of claim 1 wherein the trainline communication network access point is disposed within a locomotive.
11. A method of transmitting a signal using a trainline communication network access point, the method comprising:
  - generating a data signal capable of transmitting network data over an intra-consist electrical cable,
  - determining, from a plurality of possible transmit frequencies, masked frequencies and non-masked frequencies,
  - communicating the data signal on the transmission path on at least one of the non-masked frequencies,
  - preventing communication of the data signal on the transmission path at the masked frequencies; and
  - filtering, with a filter arrangement disposed on a transmission path between a trainline communication processor and an intra-consist electrical cable connection point connected to the intra-consist electrical cable, at least one of the masked frequencies from the transmission path.
12. The method of claim 11 further including amplifying the data signal using an analog front end amplifier.
13. The method of claim 12 wherein the filter arrangement is disposed on the transmission path between the trainline communication processor and the analog front end amplifier.

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**14.** The method of claim **12** wherein the filter arrangement is disposed on the transmission path between the analog front end amplifier and the intra-consist electrical cable connection point.

**15.** The method of claim **11** wherein the filter arrangement includes a plurality of filters.

**16.** The method of claim **11** wherein the filter arrangement includes a programmable filter.

**17.** The method of claim **16** further including commanding, with the trainline processor, the filter arrangement to filter the at least one of the masked frequencies from the transmission path.

**18.** The method of claim **11** wherein the masked frequencies and the non-masked frequencies are determined based on an amplitude map.

**19.** The method of claim **11** wherein the filter arrangement is configured to filter the at least one of the masked frequencies from the transmission path based on an amplitude map.

**20.** A locomotive consist comprising:

a locomotive;

an intra-consist electrical cable;

**12**

a trainline communication network access point disposed within the locomotive and connected to the intra-consist electrical cable, the trainline communication network access point comprising:

an intra-consist electrical cable connection point coupled to a transmission path and the intra-consist electrical cable;

a processor configured to:

generate a data signal capable of transmitting network data over the intra-consist electrical cable,

determine, from a plurality of possible transmit frequencies, masked frequencies and non-masked frequencies, communicate the data signal on the transmission path on at least one of the non-masked frequencies, and

prevent communication of the data signal on the transmission path at the masked frequencies; and

a filter arrangement disposed on the transmission path between the processor and the intra-consist electrical cable connection point, the filter arrangement configured to filter at least one of the masked frequencies from the transmission path.

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